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TECHNICAL REPORT FOR SOLID WASTE SITE REGISTRATION

DOW CHEMICAL COMPANY
OYSTER CREEK DIVISION
SOLID WASTE SITE #4

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BRAZORIA COUNTY, TEXAS

for

DOW CHEMICAL COMPANY
OYSTER CREEK DIVISION

by

UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

Approved by:

Bob Kent
Bob Kent
CPGS #4429

Approved by:

Michael W. Cooper
Michael W. Cooper, P.E.

INTRODUCTION

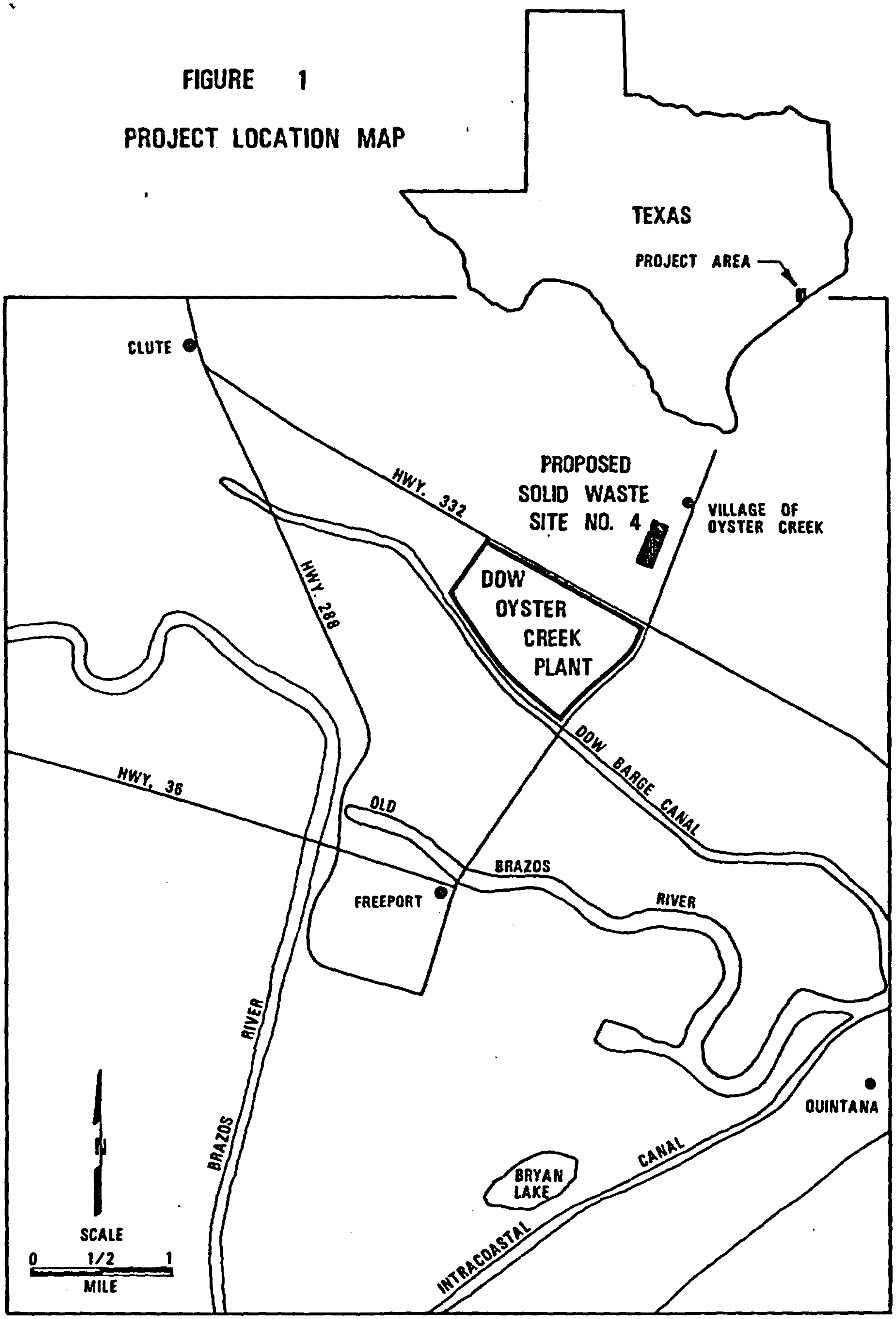
Dow Chemical Company's Oyster Creek Division is located in Brazoria County, near Freeport, Texas (Figure 1). The main plant is bounded on the north by State Highway 332, on the east by State Highway 523, and on the south by the Dow Barge Canal. Liquid and solid waste produced at the plant are disposed of by a variety of methods, including biological treatment and discharge to surface waters, incineration, on-site disposal, and off-site disposal by commercial waste disposal companies. In December 1979, Underground Resource Management, Inc. was retained to conduct a hydrologic and geologic investigation in the plant area, and to design a new solid waste disposal facility for Oyster Creek Division. Preliminary evaluation indicated that sufficient unappropriated land was not available within the main plant to develop a long term disposal site. However, a large tract of Dow-owned land was available immediately north of Highway 332. Plate 1 is a topographic map of the area and indicates the location of the proposed site relative to the main plant. Plate 2 is the survey plat of the proposed site. A legal description of the proposed site is contained in Appendix A.

SOLID WASTE GENERATION

The Oyster Creek Division operates three production units which produce vinyl chloride, chlorine/caustic and phenol acetone. Unit IV,

FIGURE 1

PROJECT LOCATION MAP



a crude oil processing plant, is currently under construction. Although a detailed discussion of the Oyster Creek Division operations is beyond the scope of this report, a general understanding of the processes is required in order to describe the solid waste products.

Vinyl Chloride Unit (Unit 1)

Unit 1 produces ethylene dichloride by both direct chlorination and oxychlorination of ethylene. Ethylene is supplied by Dow's Texas Division (also located in Freeport), and chlorine is supplied by OCD Unit II production. A copper chloride catalyst used in the process is currently disposed of at a commercial site. However, it is proposed to dispose of this catalyst at the proposed site. Heavy chlorinated tars from the direct chlorination reaction are incinerated on-site. Mud and silt dredgings from Unit 1 treatment facilities contain large amounts of soluble salts. These salts and sediments will be disposed of in the proposed solid waste site.

Chlorine Caustic Unit (Unit II)

Unit II produces chlorine and caustic by the diaphragm process. The raw material (Brine) used in the process is mined by circulating Brazos River water in salt cavities in the Stratton Ridge Salt Dome. Solid wastes produced at the facility include solids from the brine treating operations ($CaCO_3$ and $Mg\ (OH_2)$), and mud and silt dredgings from the surface facilities. This material is proposed for disposal at the new site. Other wastes from the process include chlorinated organics which are incinerated and process water which is treated and discharged.

Phenol/Acetone Unit (Unit III)

Unit III produces phenol and acetone by the cumene oxidation process. A portion of the liquid waste (cooling tower and boiler blowdown) is routed to the Unit I retention pond (where it co-mingles with Unit I effluent), hence to the Dow "A" waste canal. The organic fraction of the liquid waste is treated in a biological treatment facility prior to discharge to the "A" waste Canal. The neutralization basin is lined with an artificial membrane liner, and the treated effluent is transported via the Division pipeline to the "A" waste Canal. Solid wastes generated in the Unit include a nickel tungsten catalyst, a silica gel, mud and silt dredgings from the surface facilities, and a biofilter cake from the activated sludge treatment facility. All of these wastes plus activated carbon from air scrubbers, are candidates for disposal at the new site.

Crude Oil Processing Unit (Unit IV)

Unit IV, which is currently under construction, will process crude oil and produce petrochemical fractions such as naptha, kerosene and fuel oil for other Dow plants. Conventional oil/water separation precedes biological treatment in the wastewater treatment train. Filter cake from the biological treatment plant will be land farmed. Mud and silt dredgings from the surface facilities and perhaps other wastes will be disposed of at the proposed site.

Cathode Cleaning Facility

Near the Oyster Creek Plant, Dow Chemical Company operates a cathode cleaning facility. The cathode cleaning process generates a wash-water sludge containing sand, salts, and small amounts of asbestos fibers. Although the supernate is recycled, some sludges accumulate in the process pond. These sludges are proposed for disposal.

VOLUME OF WASTE GENERATED AND POTENTIAL LEACHATE CHARACTERISTICS

Table 1 is a listing of the waste type, estimated annual volume, and source of waste. All of these wastes are proposed for disposal. Testing and past operating experience at existing solid waste sites indicate that none of the wastes are reactive with each other, and no special handling or segregation of wastes is required.

In order to determine the possible chemical constituents of leachate from the site, ponded liquids from similar existing sites (75-1, 75-2) were collected for analysis. These ponded liquids are a combination of rain water and liquid from the solid waste. Analysis of potential leachates is contained in Table 2.

SITE INVESTIGATION

The following investigation and engineering studies were undertaken in connection with the preparation of this report:

TABLE I

SOLID WASTE PROPOSED FOR DISPOSAL

SOURCE OF WASTE	DESCRIPTION OF WASTE	TDWR CLASS	EST. ANNUAL VOLUME	TDWR CODE
Unit II Chlorine Caustic Unit	Solids from brine treating contains $CaCO_3$ and $Mg(OH_2)$	II	600 cubic yards	240470
Cathode Cleaning Facility	Wash water sludge, contains sand, salts and small amounts of asbestos.	I	1000 cubic yards	140100
Unit III (Phenol/ Acetone)	Bio-filter cake from activated sludge plant	I	1000 cubic yards	149280
Units I, II, III and IV	mud and silt from dredging of on-site treatment facilities	I	50 cubic yards	140250
Unit III Phenol/Acetone	Ni-W catalyst	I	10 cubic yards	171900
Unit III Phenol/Acetone	Silica Gel		15 cubic yards	170850
Unit I Vinyl Chloride	$CuCl_2$ catalyst (5% Cu)	I		171910
Unit III Phenol/Acetone	Activated carbon		15 cubic yards	

TABLE II

CHEMICAL ANALYSIS* OF LEACHATE

Ca	520	Mn	<0.1
Mg	22	Cr	<0.05
K	7.8	Pb	<0.1
Na	1700	Cu	<0.1
SO	30	Zn	<2.0
Cl	3368	Sn	<1.0
Fe	<.02	Ni	<0.2
TDS	6000	Phenol	307
Conductivity	9000 μmhos	Ti	<0.1
DOC**	226	Al	<0.1
		Sr	<0.7

*All analysis in ppm, except Conductivity
**Dissolved Organic Carbon

- Soil borings were performed in order to:
  - determine shallow stratigraphy
  - obtain samples for laboratory testing
  - install monitor wells
  - investigate ground-water conditions
- Samples were analyzed in the laboratory by:
  - visual examination and classification
  - Atterberg Limits tests
  - minus #200 mesh sieve tests
  - falling head permeability test.

The information obtained by field and laboratory investigations was used to determine the suitability of the site for use as a solid waste landfill.

SUBSURFACE EXPLORATIONS

Shallow stratigraphy at the proposed site was explored by six (6) soil borings and five (5) monitor well borings drilled with hollow stem augers driven by a CME 750 drilling rig. Locations of soil borings are indicated on Plate 3. Soil borings not completed as monitor wells were backfilled to the surface with clay and bentonite. Logs of borings are in Appendix B.

TABLE 3

SUMMARY OF LABORATORY TESTING TEST RESULTS
DOW SOLID WASTE SITE
NO. 4

Boring No.	Sample Depth (Ft.)	Sample Description	Unified Soil Classification Designation	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Minus 200	Permeability cm/sec
SB-1	0-1.5	Dark Gray Clay	CH	60	97	26	71		
	3-3.5	Dark Gray Clay	CH	43	73	19	54		
	6-6.5	Gray Clay	CH	28	55	15	40		
	9-10.5	Dark Gray Clay	CH	53	100	30	70	98	$9x10^{-9}$
	15.5-16	Gray Sandy Clay	CL	23	44	15	29	92	$5x10^{-8}$
	24.5-25	Gray Clay	CH	35	85	24	61	99	
	34.5-35	Gray Clay	CH	28	73	16	57		
SB-2	1-1.5	Dark Gray Clay	CH		90	32	58		
	10-10.5	Dark Gray Clay	CH	44	82	25	57	98	
	15-15.5	Tan Sandy Clay	CL-SC	20				52	$1x10^{-6}$
	17-17.5	Tan Sand	SC	26				15	
	29-29.5	Bluish Gray Clay	CH	32	72	25	47	97	$1x10^{-8}$
SB-3	0.5-1.0	Dark Brown Clay	CH	56	100	26	84		
	9-10	Dark Brown Clay	CH		84	23	61	98	
	10-10.5	Light Gray Sandy Clay	CL	42	35	19	16	78	$4x10^{-9}$
	19-20.5	Tan Sand	SC					13	
	27-28.5	Tan Sand	SP					9	
	34.5-35	Gray Clay	CH	29	71	20	51	99	
SB-4	5-5.5	Dark Brown Clay	CH	43	82	25	57		
	15-15.5	Gray Clay	CH	27	65	22	43	94	$2x10^{-9}$*
SB-5	4.5-5	Gray Clay	CH	49	93	27	66	99	$4x10^{-9}$*
	9.5-10	Gray Clay	CH	49					
	14.5-15	Reddish Brown Silty Clay	CL	22	30	20	10	95	
	20-20.5	Reddish Brown Clay	CH	33	68	24	44	100	
	30-30.5	Gray Clay	CH	27	58	15	43		$4x10^{-8}$*
SB-6	5-5.5	Reddish Brown Clay	CH	43	79	26	53		$6x10^{-9}$
	15-15.5	Light Silty Gray Clay	CL	23	30	20	10	96	
	29-29.5	Gray Clay	CH	32	79	25	55		

Permeability Tests were run with City of Austin tap water, except where indicated with an *. These tests were run with surface water which had been in contact with solid waste.

the well bore annulus and the casing. A 2' x 2' concrete pad was installed at the surface of each well to add stability to the wellhead and direct surface runoff away from the well.

Prior to well installation, the boreholes were bailed, and water samples collected for analyses. After installation, the wells were again bailed and sampled. Water level measurements and conductivity readings were recorded. The well sites were cleaned up, and permanent identification plaques mounted on each well. Monitor well locations are indicated on Plate 3 and construction details contained in Appendix D.

SUBSURFACE CONDITIONS

Based on data developed during this investigation, the sediments under the proposed landfill consist of a minimum of 10 feet of clay with permeabilities of less than 1×10^{-7} cm/sec. (the minimum requirements set by the TDWR and the EPA for natural landfill soil liners). Underlying these clays are between 1 to 25 feet of lenticular and interfingering deposits of sandy clays and sands probably associated with crevasse splays or old channels. Permeability of these sediments is $\pm 10^{-3}$ cm/sec.

Underlying this first permeable zone, an additional 5 to 20 feet of relatively impermeable clays were present in all soil borings. Permeability tests indicate permeability ranges of 10^{-8} to 10^{-9} cm/sec, within acceptable ranges of permeability for solid waste disposal sites. Data developed during the drilling program was utilized to construct cross-sections A-A[1] and B-B[1], Plate 3.

POTENTIAL MIGRATION OF LEACHATE

The movement of leachate through the saturated zone is a complex subject. Many factors act upon the organic and inorganic substances which could occur in the leachate generated at the proposed site. These factors, which include biological degration, filtration, adsorption and absorption, are frequently referred to collectively as attenuation. Generally, heavy clay soils, such as exist in the project area, have better attenuation capacities than sands or silts. Studies by Sands, et al (1975) indicate the Beaumont clay has a high attenuation capacity. Actual pollution or leachate migration is best detected by utilizing key indicators which are generally not affected by the attenuation processes. The study of attenuation is beyond the scope of this study. Any potential movement of leachate will be described in terms of transport by the natural flow system in the saturated zone, assuming flow in the area follows Darcy's law. By rearranging Darcy's law: $\bar{v} = \frac{Q}{A} = K\frac{dh}{dL}$

where:

$\bar{v}$ = apparent velocity through the entire area A

Q = flow rate

A = cross-sectional area

K = hydraulic conductivity

h = head loss along L

L = path length of porous medium through which flow occurs.

The apparent velocity can be converted to average velocity by dividing by the porosity of the flow medium or:

$$v = \frac{\bar{v}}{\emptyset} = \frac{Q}{A\emptyset} = \frac{K}{\emptyset}\frac{dh}{dL}$$

where: v = average velocity and ∅ = average porosity expressed as a decimal.

In the project area, the ground-water gradient was established by surveying the elevation and location of 5 monitor wells and by measuring the static water level. The elevation of the top of each well casing was established by measuring the height of the casing above a pre-established datum. The construction of the water table map (Plate 3) showed that several errors in elevations probably exist. The top of the casings are probably at a lower elevation than indicated. While the water table map gives the appearance that the water table is several inches above the ground surface, its actual elevation is level with the ground surface, or a few tenths-of-a-foot below.

Two lateral rates of natural ground-water movement can be calculated: one for migration of water in the surficial clay sediments at the site and one for the sandy strata below the clays. The minimum value of the hydraulic conductivity of the saturated clays, as determined by laboratory tests, was 1×10^{-7} cm/sec (see Table of Lab test). The results of a Bailer test in monitor well OCD4-5 indicated a hydraulic conductivity of 1.19×10^{-3} cm/sec in the sandy sediments of the area (Appendix E). The porosity of both the clay and sandy strata was assumed to be 30%. Lateral migration of groundwater in the saturated clays was calculated to be 0.00023 ft/year. If leachate from the landfill did move vertically through the clays and entered the sandy strata below the site, the lateral migration of water in that sandy strata would be on the order of 0.23 ft/year. The groundwater in both the clays and sands would move to the south in response to the shallow ground-water gradient.

Between the bottom of the sandy unit and the potentiometric surface of the regional aquifer, there are over 30 feet of sediments of low permeability. Leachate migration from the proposed site into the shallow or regional aquifer is not considered probable.

SHALLOW GROUND-WATER QUALITY

During the field investigation, numerous water samples were collected for chemical analyses from boreholes and monitor wells. All samples were transported to the Dow Chemical Oyster Creek Division Laboratory for testing. Results of the chemical analyses are contained in Table 4; Gas chromatograph and/or GC-Mass spec scans of the liquid samples are contained in Appendix F. As indicated by the chemical analyses in Table 4, the shallow groundwater is of extremely poor chemical quality. The SO_4/Cl^- ratios and the concentration of strontium found in the samples indicate a resemblance to sea water. The Ca/Mg ratio appears to be lower. This is probably a result of Mg or Na to Ca exchange which would occur in the calcium montmorillonite clays present at the site. These shallow sands have probably been impacted

TABLE 4

CHEMICAL ANALYSES* OF SAMPLES FROM MONITOR WELLS AND SOIL BORINGS - SOLID WASTE SITE #4

	OCD4-1B	OCD4-2A**	OCD4-2B	OCD4-3A**	OCD4-3B	OCD4-4A**	OCD4-4B	OCD4-5A**	OCD4-5B	SB6**	SB4**	SB1**	SB2**	SB3**
Ca	1,400	1,700	1,800	1,000	940	1,300	1,300	1,000	1,200	1,600	1,300	1,100	1,400	1,600
Mg	1,200	1,200	1,300	770	730	860	970	910	860	1,200	1,000	750	820	970
K	11	10	12	11	8.9	12	12	14	13	8.9	11	16	8.9	18
Na	6,900	7,000	7,000	5,300	5,200	5,400	5,600	6,600	6,400	7,700	5,400	4,500	5,900	5,800
HCO_3	250	244	287	268	317	220	342	207	207	275	256	317	348	323
SO_4	3,000	2,700	2,900	2,700	2,600	2,600	2,700	2,700	2,700	2,900	2,700	2,600	2,800	2,500
Cl	18,434	16,307	16,484	10,990	9,926	12,408	12,053	13,117	12,762	16,839	11,699	10,281	12,408	12,939
Fe	4.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	5.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO_3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TDS	33,880	29,390	29,330	20,850	21,010	21,920	21,500	23,230	24,860	30,570	22,630	20,755	25,850	25,260
Spec. Cond.	40,000	36,000	35,000	27,000	28,000	29,500	29,500	29,000	29,000	40,000	29,000	26,000	32,500	32,000
DOC	40	48	62	53	61	55.5	66	63	71	73	60.5	64	66.5	75.5
GC Organic Scan	94.6	1.8				2.7	34.0	0.6	3.8	1.9	1.1	1.1	0.9	0.8
Mn	1.0	1.2	1.1	1.0	1.1	1.3	1.5	1.2	<0.1	<0.1	1.4	<0.1	1.4	1.5
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cr	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cu	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zn	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Sn	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ni	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Al	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
As	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sr	5.8	7.4	6.5	5.6	4.8	4.6	4.3	4.6	4.5	6.3	4.3	4.5	5.5	4.3
Ti	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

*All analyses in ppm, except specific conductance (Spec. Cond.)
**Indicates samples collected in open boreholes.

REGIONAL GEOLOGY AND GROUND-WATER RESOURCES

The surface sediments in the project area consist of interdistributary silts and muds including crevasse splay deposits which are associated with recent (Holocene) sedimentation cycles. Underlying these deposits, are approximately 1,000 feet of Pleistocene deposits and over 35,000 feet of Tertiary sediments. A review of drillers logs and soil boring data indicates the Holocene and Pleistocene deposits are similar in nature. It is not practical to attempt to delineate the base of the Holocene. The geologic units which contain fresh to slightly saline groundwater in the project area are the Goliad Sand, Willis Sand, Bentley Formation, Beaumont Clay and the Quaternary Alluvium. These units range in age from Pliocene to Holocene. Figure 2 is a stratigraphic-hydrogeologic correlation chart for the project area and attempts to correlate various geologic and hydrologic terms used in this report. The formations are similar in nature and generally consist of lenticular and interbedded deposits of sand, silt and clay. Smaller amounts of gravel and shell deposits also exist. The formations dip toward the Coast at an angle greater than the slope of the land surface and, therefore, occur at deeper depths toward the Coast. The sediments with each formation also appear to thicken Gulf-ward.

Plate 4 is an environmental geologic map of the project area. This type of geologic map differs from conventional maps in that no age or stratigraphic relationship is implied. Rather, the units are

FIGURE 2 STRATIGRAPHIC AND HYDROLOGIC UNITS

<table>
<tr><th>SYSTEM</th><th>SERIES</th><th>STRATIGRAPHIC UNIT</th><th colspan="2">HYDROLOGIC UNIT</th><th>APPROXIMATE DEPTH IN DOW AREA</th><th>APPROXIMATE WATER QUALITY TDS</th></tr>
<tr><td rowspan="4">QUATERNARY</td><td>HOLOCENE</td><td>ALLUVIUM</td><td rowspan="5">CHICOT AQUIFER</td><td>UPPER</td><td>300 FT.</td><td>1000 MG/L</td></tr>
<tr><td rowspan="3">PLESTOCENE</td><td>BEAUMONT</td><td rowspan="4">LOWER</td><td rowspan="4">1100 FT.</td><td rowspan="4">1000-
2000 MG/L</td></tr>
<tr><td>MONTGOMERY</td></tr>
<tr><td>BENTLEY</td></tr>
<tr><td rowspan="2">TERTIARY</td><td rowspan="2">PLIOCENE</td><td>WILLIS</td></tr>
<tr><td>GOLIAD</td><td colspan="2">EVANGELINE AQUIFER</td><td></td><td>2000-
3000 MG/L</td></tr>
</table>

lithologic and/or process derived. In the immediate area of concern, the predominate sediments are clays, interbedded with silts, sands and silty clays.

Most groundwater produced in the Dow area is from the Chicot Aquifer. In the project area, the base of this hydrologic unit occurs between 1100 to 1300 feet below sea level. The separation between the Chicot and underlying Evangeline Aquifers can usually be distinguished by lithology, permeability, and water levels. In the project area, the distinction can also be made by differences in water quality. In Brazoria County, the Chicot Aquifer is divided into a upper and lower unit. The Upper Chicot consists of interbedded sands and clays. In the Dow area, the base of the Upper Chicot occurs at approximately 300 feet below the land surface and furnishes potable water to the Oyster Creek Division, numerous other industrial users and area residents. Plate 5 is a regional hydrologic cross-section indicating aquifers and water quality. Plate 6 is a potentiometric surface map of the Upper Chicot.

Within one mile of the project area, there are numerous residents. Currently, most of these residents are served by individual wells, although some wells serve several houses or trailers. The Village of Oyster Creek is installing a public water supply system. Two new public supply wells will be drilled approximately one mile from the proposed landfill site. These wells will replace the existing net- [illegible] wells in the Oyster Creek area. The large number of [illegible] wells. However, most of the dwellings and buildings indicated on Plate 1 have individual wells.

REGIONAL GROUNDWATER QUALITY

During this investigation, the records of over 70 wells were reviewed, including all well records on file with the TDWR within a one mile radius of the proposed site. An on-site survey indicates significantly more wells in the Oyster Creek area than are listed by the TDWR. With the exception of one well, all wells reviewed are completed in the Upper Chicot.

Chemical analyses of water from Dow water wells in the project area are contained in Table 5. These analyses include those taken from the files of the Texas Department of Water Resources, those collected during this investigation and data from Dow files.

The chemical quality of water produced by the Oyster Creek Division wells is representative of water produced from the Upper Chicot Aquifer and appears the best quality water available in the Freeport area. Typically, the total dissolved solids content ranges between 900 to 1200 milligrams per liter; the major ions are sodium, bicarbonate and chloride. The quality of the Lower Chicot is typified by the analysis of water from the Shintech well located west of the project area. This well, completed at a depth of 500 feet, produces water with

TABLE 5
CHEMICAL ANALYSES OF WATER FROM WELLS
IN THE VICINITY OF DOW OYSTER CREEK DIVISION
BRAZORIA COUNTY, TEXAS

Well #	Owner	Depth of Well(ft)	Date of Collection	Cal-cium (Ca)	Mag-ne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Dis-solved Solids (sum)	Mn	T Fe	pH
1	Dow Oyster Creek	204	1-30-79	43	18	215		506	<5	165	.5	<.1	953	.08	1.1	
4a	Dow Oyster Creek	±200	1-30-79	34	11	269		601	<5	158	.6	<.1	1082	<.05	.34	
5	Dow Oyster Creek	304	1-30-79	49	20	234		542	<5	191	.5	<.1	1043	<.05	2.3	
7	Dow Oyster Creek	200	1-30-79	29	14	252		627	<5	116	.6	<.1	1043	<.05	.45	
8a	Dow Oyster Creek	±200	1-30-79	27	13	304		634	<5	186	.7	<.1	1172	<.05	<.05	
9	Dow Oyster Creek	232	1-30-79	52	19	233		527	<5	200	.5	<.1	1041	<.05	.92	
11	Dow Oyster Creek	208	1-30-79	34	19	262		610	<5	163	.5	<.1	1091	<.05	.61	
19	Dow Oyster Creek	220	1-30-79	29	12	281		666	<5	131	.6	<.1	1126	.05	.39	
21	Dow Oyster Creek	±200	1-30-79	44	21	209		534	<5	150	.6	.3	969	.06	.8	
23	Dow Oyster Creek	202	10-29-79	33	15	206		505	0	127	.5	.3	902	<.05	.55	7.42
24	Dow Oyster Creek	203	1-30-79	37	15	227		575	<5	123	.6	<.1	987	<.05	.3	
	Near O.C. (Layne-Tex)	238		34	16	276		573	2	196	.4	1.4	1098	.03	.07	7.46
	Dow Plant B	212		38	16	227		456	2.4	160			1041			8.4
	Dow Plant B	240		39	13	237		420	2.7	180			900			8.1
	Dow Plant B	238		31	12	256		483	2	140			942			8.2
	Dow Plant B	1146		56	21	1086		252	24	1640		.8	2910			7.7
	Shintech	500	1-30-79	24	12	492		548	<5	516	0.5	<.1	1605	<.05	.24	

ALL ANALYSES IN MG/L, EXCEPT pH.

1605 mg/l of total dissolved solids. As with the Upper Chicot, the major ions are sodium, bicarbonate, and chloride, although at significantly higher concentrations. Water quality data for the Evangeline Aquifer is indicated by the analysis for a Dow Plant "B" well which was completed at a depth of 1146 feet. This well produces water containing 2910 mg/l TDS.

FAULTING AND SUBSIDENCE

A review of the literature and aerial photos indicates a lack of surface faults or lineations in the project area, However, numerous linear anomalies have been mapped north of the project area. These lineations, which are normally parallel to the Coast, are probably of structural origin, and many of the surface lineations can be correlated to the surface traces of extrapolated subsurface faults. Although these faults are related to the geologic history of the area, evidence indicates that man's activities can increase the frequency or rate of surface fault movement. In the Houston/ Galveston County area, the activation of surface faulting has been correlated to increased ground-water withdrawals and resultant compaction of the sediments. Frequently, subsidence will occur only on one side of a fault block. Therefore, the faults may be a barrier to horizontal ground-water flow. In the immediate project area, less than one foot of subsidence has occurred. This has been attributed to large ground-water withdrawals for municipal and industrial use. Dow Oyster Creek Division and the Village of Oyster Creek are currently developing groundwater supply systems, and some additional subsidence could develop in those areas. Additional subsidence is not expected to occur at the proposed landfill site. Surveys will be performed every 5 years to determine correct elevations.

HURRICANE PROTECTION

The project site, along with most of the Texas Gulf Coast area is subject to flooding by hurricane-induced tide surges. Hurricane surge heights have been estimated by Marmos and Woodward (1968) for standard projected hurricanes. These projections represent the most severe combination of hurricane parameters that are characteristic of the region. A surge height of 12.8 feet was calculated for Freeport for a 100-year reoccurrence interval of hurricane central pressure index. The project area is protected by a Corps of Engineers levee with a crown elevation of 15 feet. The project area is located in zone A3 of Flood Hazard Boundary Map H-83 and Flood Insurance Rate Map I-83. The 100 year base flood elevation of this zone is 5.5 feet msl.

CLIMATE

The project area is located in a humid region. The area has a mean annual temperature of 70°F and relatively high humidity. A review of climatological data for a period of 35 years indicates an average annual rainfall of approximately 46 inches and a pan evaporation of approximately 43 inches. The maximum expected 24-hour rainfall on a 50 year frequency is 14.21 inches. Winds in the project area are generally from the southeast from March through November, with frequent strong northeast winds from December through February. Since the project site is located southwest of the major population center (Village of Oyster Creek), stray odor problems are not expected to be a problem.

SITE DESIGN

The proposed site will be 300 by 1500 feet, or approximately 10.33 acres. However, the entire site will not be utilized at one time. Based on past records, the plant will generate approximately 3,000 cubic yards of material to be disposed of each year. In each cell, there will be over 7,000 cubic yards of storage space, allowing for a one-foot leachate collection system and two feet of free board. Each cell should last approximately 2.3 years. The entire facility is designed for 7 cells or a total operational life of 16 years. Plate 7 is an engineering drawing of the proposed site. A typical dike cross-section and the leachate collection system are also indicated. Leachate and/or groundwater which accumulates in the leachate collection system will be collected and pumped to the Unit IV treatment system prior to discharge. After each cell is closed and capped, additional pumpage requirements will be minimum.

Rainfall Runoff

Rainfall, which accumulates within the active cell of the landfill will be removed via the leachate collection system and piped to surface treatment facilities at the main plant. If the permeability of the solid waste is too low to allow infiltration, the surface water can be removed with a floating pump. Rainfall which accumulates in the diked future disposal area will be removed and discharged to the surface. The dike surrounding the site will be constructed to an elevation of 8.5 feet above msl and will not allow surface water to enter the site. A minimum 2' free board will be maintained to prevent overflow during storms. If releveling surveys indicate subsidence of the facility, below flood elevations, the crown height of the dike will be raised.

SITE OPERATION

Solid waste generated within the Division will be transported to the site, as required. It is anticipated that company driven vehicles will be utilized, although, at times, contract vehicles may be utilized. Some waste may be transported by pipelines. In order to get from the main plant area to the disposal site, the trucks must drive across a public road (State Hwy. 332). The proposed transportation route is indicated on Plate 2.

The active portion of the site will be enclosed by a 6 foot industrial fence which will be kept locked when not in use. Past operating experience with the waste proposed for disposal indicates no major odors or reactions will occur. Some of the material is sludge and will contain moisture which will be collected by the leachate collection system. As the waste sludge becomes stable and dewatered, dry fill will be added. Prior to completion of one cell, a new dike and leachate collection system will be installed and a new cell created. After start-up of the new cell, final cover will be added to the filled area. Past operating experience indicates that these sites can be closed by proper placement of fill and some dry cement. Some settling of the fill is anticipated over a long period of time. The closed cells will be monitored, and fill added as needed to maintain grade. After settling is complete, the site will be graded, top soil applied and seeded to prevent erosion.

LAND FARMING OPERATION

It is anticipated that all of the 10-acre site will not be needed for 12 to 16 years, and as indicated in the operating plan, only one cell at a time will be constructed. In order to effectively utilize the land, Dow may utilize a portion of the 10-acre tract as a land farming operation. As more area is needed for solid waste disposal, land farming in that area will be discontinued, and a new cell constructed. The soil and organic residual from the land farm area will be disposed of in the old cell. Details concerning the land farming operation (including runoff collection) will be submitted at a later date. Soil studies performed during this investigation indicate the soils are suitable for land farming, however, more complete testing, including cation exchange tests will be conducted.

LEGAL DESCRIPTION OF DOW OYSTER CREEK SOLID WASTE DISPOSAL SITE #4

The following is a legal description of a 10.3298 acre tract of land which is located within a 493.66 acre tract. conveyed by D. J. Sullivan to Dow Chemical Company by deed dated October 26, 1940 and recorded in Volume 334, Page 587, of the Brazoria County, Texas deed records, and being also a part of the M. Henry 1/4 League, A-74:

Beginning, as a reference, at the most northeast corner of the above 493.66 acre tract which is marked by a concrete monument set at the fenceline which marks the north boundary of the Dow 493.66 acre tract, and from which a 1-1/4" Iron Pipe, set in concrete at the fence corner which marks the northwest corner of the F. J. Calvit League A-51, bears N86°50'E a distance of 540.00 feet;

Then S42°10'30"W a distance of 284.53' to an iron stake set for the northeast corner of the 10.3298 acre tract, which is the point of beginning;

Then S2°29'E a distance of 1500.00 feet along the east boundary of the 10.3298 acre tract, to an iron stake set for the southeast corner of this 10.3298 acre tract;

Then S86°50'W a distance of 300.00 feet along the south boundary of this 10.3298 tract to an iron stake set for the southwest boundary of the 10.3298 acre tract;

Then N2°29'W a distance of 1500.00 feet along the west boundary of the 10.3298 acre tract to an iron stake set for the northwest corner of the 10.3298 acre tract;

Then N86°50'E a distance of 300.00 feet along the north boundary of the 10.3298 acre tract to an iron stake set for the northeast corner of this 10.3298 acre tract, which is the point of beginning.

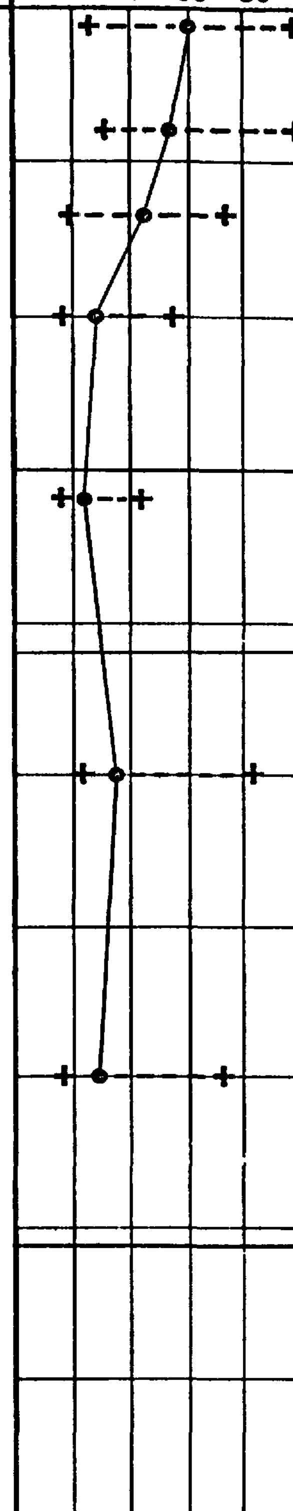
I certify that the above description is true and correct and that it accurately describes the boundaries of a tract of land as established by a survey performed on the ground in December, 1979.

James G. Moore

James G. Moore, P.E.
43638

STATE OF TEXAS
J. G. Moore
43638
REGISTERED
PROFESSIONAL ENGINEER

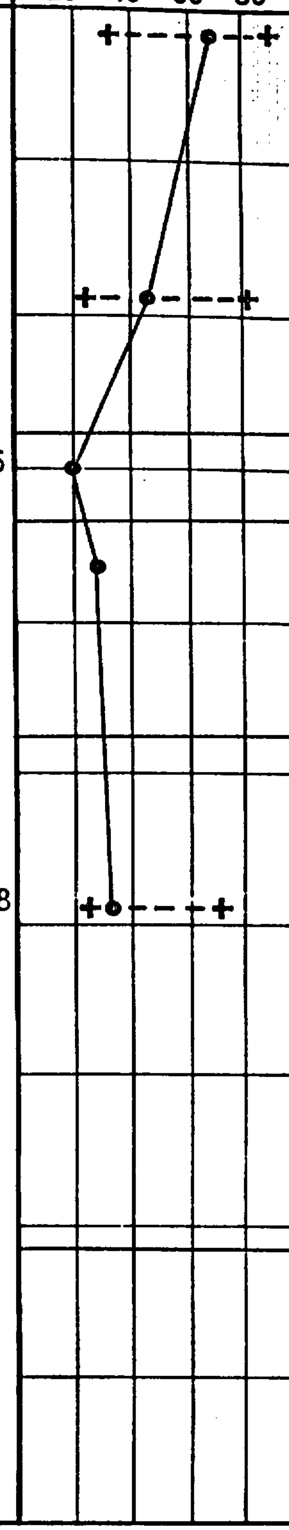
DEPTH (FT)	SYMBOL	TYPE	SOIL DESCRIPTION Boring No.: SB-1 Date: 1/8/80	K cm/sec	MOISTURE STATES % +— — —O— — —+ PL W LL 20 40 60 80	MINUS 200 SEVE (%)
		ST	CLAY, highly plastic, soft, dark gray with reddish brown staining, organic material, (CH).			
		ST		$9x10^{-9}$		98
5			- firm below 5 ft.			
		ST				
10		ST	- calcareous below 10 ft.			
		ST				
15		ST	SANDY CLAY, moderately plastic, firm, 5-10% fine sand, calcareous nodules, gray, (CL).	$5x10^{-8}$		92
		ST				
20						
		ST	CLAY, highly plastic, firm to stiff, gray, (CH).			
25		ST				99
30		ST				
35		ST				
40		ST				
			Boring Terminated @ 40.5 ft.			



UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

LOG OF BORING
SOLID WASTE SITE
NO. 4

DEPTH (FT)	SYMBOL	TYPE	SOIL DESCRIPTION — Boring No.: SB-2 Date: 1/8/80	K cm/sec	MOISTURE STATES % (+ PL, O W, + LL; 20 40 60 80)	MINUS 200 SEVE (%)
0–14		ST, ST (5), ST (10)	CLAY, highly plastic, soft, dark gray with roots to 1.5 ft., (CH) - firm with reddish brown staining below 4 ft.			98 98
14–17		ST (15)	SANDY CLAY, slightly plastic, 48% fine sand, tan, (CL-SC)	1x10^{-6}		52
17–24		ST, ST	SAND, uniform fine, 15% clayey fines, tan, (SC)			15
24–40.5		ST (25), ST (30), ST (35), ST (40)	CLAY, highly plastic, stiff, bluish gray, (CH).	1x10^{-8}		97
			Boring Terminated @ 40.5 ft.			



UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

LOG OF BORING
SOLID WASTE SITE
NO. 4

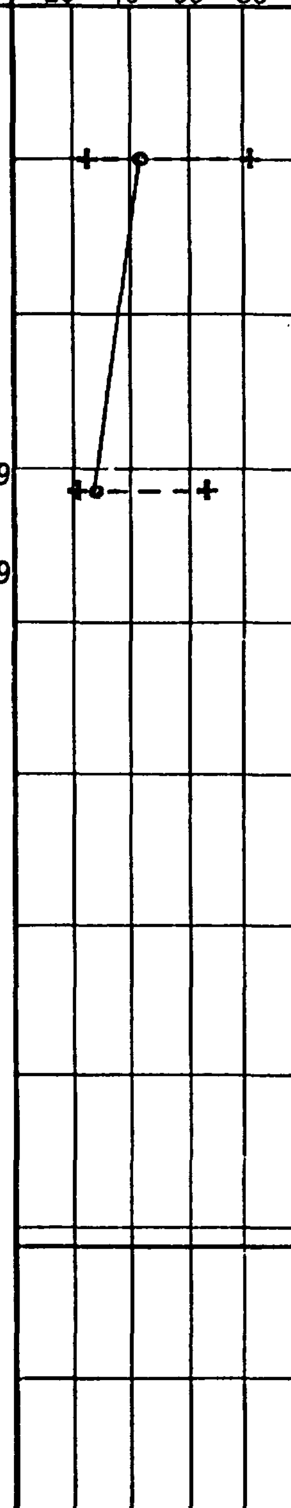
Boring No.: SB-3 Date: 1/9/80

DEPTH (FT)	TYPE	SOIL DESCRIPTION	K cm/sec	MOISTURE STATES % (+ PL, o W, + LL; 20 40 60 80)	MINUS 200 SIEVE (%)
	ST	CLAY, highly plastic, soft, dark brown with roots to 1.5 ft., (CH).			
5	ST	- firm below 4 ft., light gray with dark brown stains			
10	ST				98
		SANDY CLAY, moderately plastic, 22% fine sand, light gray, (CL).	4×10^{-9} water		78
15	ST	SAND, uniform fine, tan, (SP)	4×10^{-9} waste		
		- cemented 14.5-15			
20	ST				13
25	ST				
	ST				9
30	ST	CLAY,			
35	ST	CLAY, highly plastic, stiff, gray with reddish brown stains, (CH).			99
40	ST				
		Boring Terminated @ 40.5 ft.			

UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

LOG OF BORING
SOLID WASTE SITE
NO. 4

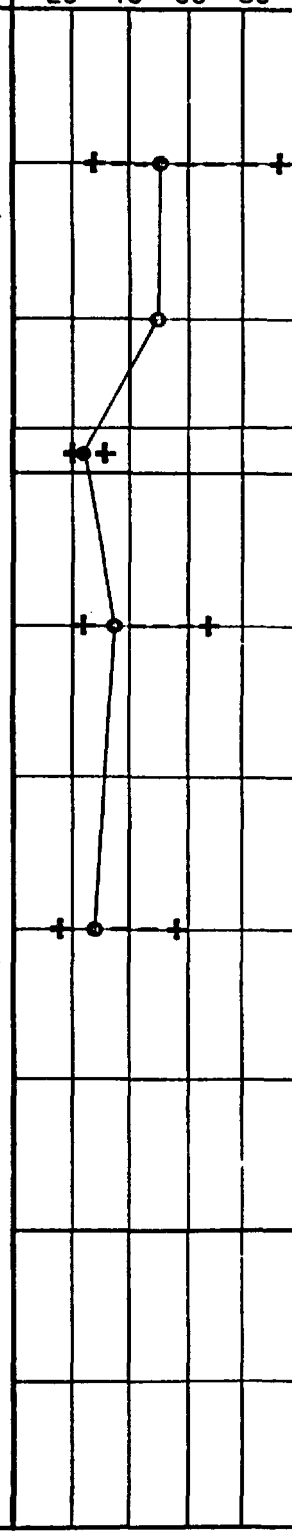
DEPTH (FT)	SYMBOL	TYPE	SOIL DESCRIPTION Boring No.: SB-4 Date: 1/14/80	K cm/sec	MOISTURE STATES % (+ PL, o W, + LL) 20 40 60 80	MINUS 200 SEIVE (%)
		ST	CLAY, highly plastic, soft, dark brown, with roots to 1.5 ft., (CH).			
5		ST	- firm below 4 ft.			
10		ST	- gray with reddish brown stains			
		ST				
15		ST	- calcareous nodules and calichification to 21 ft.	$2x10^{-9}$ water		94
		ST		$2x10^{-9}$ waste		
20			- stiff below 20 ft.			
		ST				
25		ST				
30		ST				
35		ST				
40		ST				
			Boring Terminated @ 40.5 ft.			



UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

LOG OF BORING
SOLID WASTE SITE
NO. 4

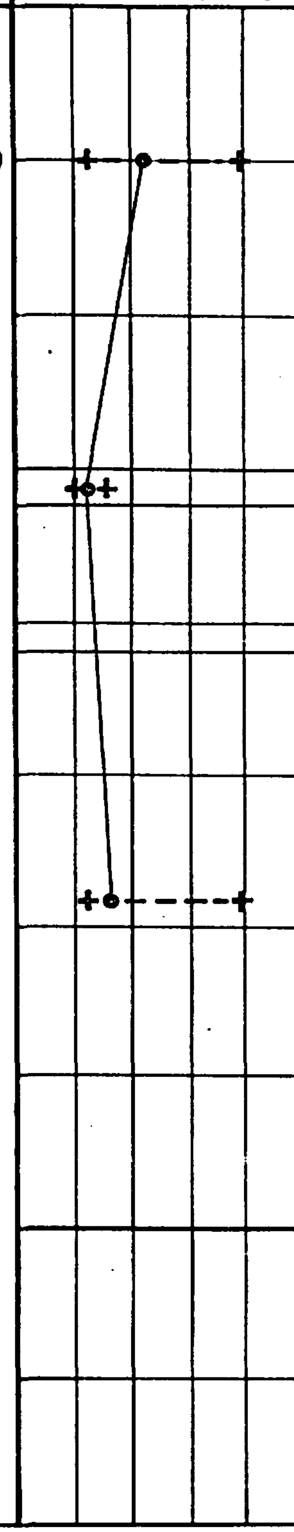
DEPTH (FT)	SYMBOL	TYPE	SOIL DESCRIPTION Boring No.: SB-5 Date: 1/9/80	K cm/sec	MOISTURE STATES % +— PL — —O— W — —+ LL 20 40 60 80	MINUS 200 SIEVE (%)
		ST	CLAY, highly plastic, soft, dark reddish brown, roots to 1.5 ft., (CH).			
5		ST	- firm below 4 ft.	$4x10^{-9}$ water $4x10^{-9}$ waste		99
10		ST	- calcareous nodules @ 10 ft.			
15		ST	SILTY CLAY, slightly plastic, reddish brown, (CL). - SAND seam @ 14 ft.			95
20		ST	CLAY, highly plastic, stiff, reddish brown, (CH).			100
25		ST	- gray with reddish brown stains below 25 ft.			
30		ST		$4x10^{-8}$ water $4x10^{-9}$ waste		
35		ST				
40		ST	Boring Terminated @ 40.0 ft.			



UNDERGROUND RESOURCE MANAGEMENT, INC.
Austin, Texas

LOG OF BORING
SOLID WASTE SITE
NO. 4

DEPTH (FT)	SYMBOL	TYPE	SOIL DESCRIPTION Boring No.: SB-6 Date: 1/14/80	K cm/sec	MOISTURE STATES % +– – –O– – –+ PL W LL 20 40 60 80	MINUS 200 SIEVE (%)
		ST	CLAY, highly plastic, soft, dark brown, roots to 1.5 ft., (CH).			
5		ST	- firm and reddish brown below 4 ft.	$6x10^{-9}$		
10		ST	- light gray and calcareous below 9 ft.			
		ST				
15		ST	SILTY CLAY, slightly plastic, light gray, (CL)			96
		ST	SAND, uniform fine, light gray with calcareous nodules, (SP). - reddish brown @ 18.5 ft.			
20						
		ST	CLAY, highly plastic, stiff, reddish brown, (CH). - gray below 22 ft.			
25		ST				
30		ST				
35		ST	- brown with calcareous nodules			
		ST				
40			Boring Terminated @ 40.0 ft.			



UNDERGROUND RESOURCE MANAGEMENT, INC
Austin, Texas

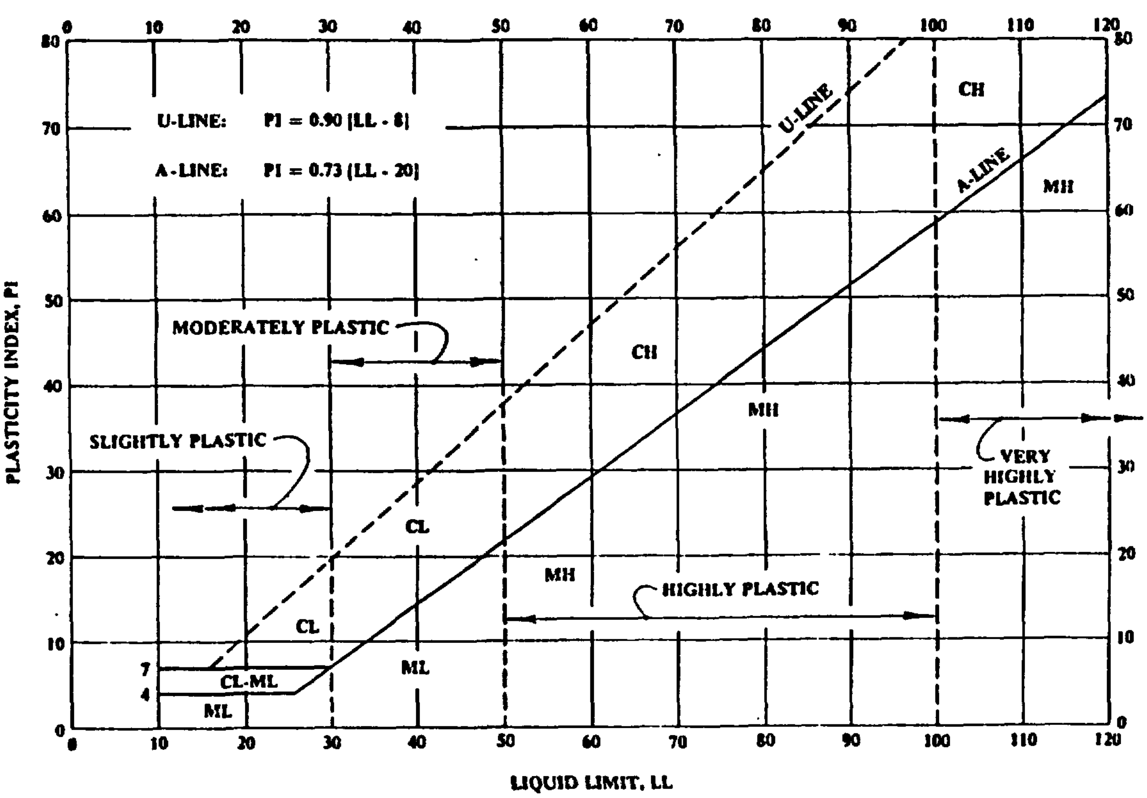
LOG OF BORING
SOLID WASTE SITE
NO. 4

UNIFIED SOIL CLASSIFICATION SYSTEM

GRADATION AND PLASTICITY CHARACTERISTICS (Excluding particles larger than 3 in.)				GROUP SYMBOL	SOIL NAMES
PREDOMINANTLY COARSE-GRAINED More than 50% of soil retained by No 200 Sieve	GRAVEL More than 50% of coarse-grained fraction retained by No. 4 sieve	CLEAN Less than 5% fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	GW	Well-graded GRAVEL or SANDY GRAVEL
			Not meeting all gradation requirements for GW	GP	Poorly graded, uniform, or gap-graded GRAVEL or SANDY GRAVEL
		WITH FINES More than 12% fines*	Atterberg limits below A-line or PI less than 4	GM	SILTY GRAVEL
			Atterberg limits above A-line with PI greater than 7†	GC	CLAYEY GRAVEL
	SAND More than 50% of coarse-grained fraction passes No 4 sieve	CLEAN Less than 5% fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	SW	Well-graded SAND or GRAVELLY SAND
			Not meeting all gradations requirements for SW	SP	Poorly graded, uniform, or gap-graded SAND or GRAVELLY SAND
		WITH FINES More than 12% fines*	Atterberg limits below A-line or PI less than 4	SM	SILTY SAND
			Atterberg limits above A-line with PI greater than 7†	SC	CLAYEY SAND
PREDOMINANTLY FINE-GRAINED More than 50% of soil passes No. 200 sieve	Plasticity characteristics of fraction passing No 40 sieve: SILT Atterberg limits below A-line or PI less than 4	INORGANIC	Liquid limit less than 50	ML	Nonplastic, slightly plastic, or moderately plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
			Liquid limit greater than 50	MH	Highly plastic or very highly plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
		ORGANIC	Liquid limit less than 50	OL	Slightly plastic or moderately plastic ORGANIC SILT (ORGANIC CLAY if Atterberg limits above A-line)
			Liquid limit greater than 50	OH	Highly plastic or very highly plastic ORGANIC SILT (ORGANIC CLAY if Atterberg limits above A-line)
	CLAY Atterberg limits above A-line with PI greater than 7†		Liquid limit less than 50	CL	Slightly plastic or moderately plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
			Liquid limit greater than 50	CH	Highly plastic or very high plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
HIGHLY ORGANIC (identified by spongy feel)				Pt	PEAT

*Predominantly coarse-grained soil with 5% to 12% fines is borderline case requiring use of dual symbol, such as GW-GC or SM-SP.

†Atterberg limits above A-line with PI between 4 and 7 is borderline case requiring use of dual symbol, GC-GM or SC-SM for predominantly coarse-grained soil or CL-ML for predominantly fine-grained soil.



PLASTICITY CHART

KEY TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPE
(Shown in Symbol Column)

Sand Silt Clay

FILL Sandy Silty Clayey

Predominant type shown heavy

SAMPLE TYPE
(Shown in Samples Column)

Undisturbed Rock Core Split Spoon No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (Major Portion Retained on No. 200 Sieve)

Includes (1) clean gravels & sand described as fine, medium or coarse, depending on distribution of grain sizes & (2) silty or clayey gravels & sands (3) fine grained low plasticity soils (PI < 10) such as sandy silts. Condition is rated according to relative density, as determined by lab tests or estimated from resistance to sampler penetration.

Descriptive Term	Penetration Resistance *	Relative Density
Loose	0 — 10	0 to 40 %
Medium Dense	10 — 30	40 to 70 %
Dense	30 — 50	70 to 90 %
Very Dense	Over 50	90 to 100 %

**Blows/Ft., 140# hammer, 30" drop*

FINE GRAINED SOILS (Major Portion Passing No. 200 Sieve)

Includes (1) inorganic & organic silts & clays, (2) sandy, gravelly or silty clays, & (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests for soils with PI ≥ 10

Descriptive Term	Cohesive Shear Strength Tons/Sq. Ft.
Very Soft	Less Than 0.125
Soft	0.125 to 0.25
Firm	0.25 to 0.50
Stiff	0.50 to 1.00
Very Stiff	1.00 to 2.00
Hard	2.00 and Higher

NOTE: SLICKENSIDED AND FISSURED CLAY MAY HAVE LOWER UNCONFINED COMPRESSIVE STRENGTHS THAN SHOWN ABOVE, BECAUSE OF PLANES OF WEAKNESS OR SHRINKAGE CRACKS; CONSISTENCY RATINGS OF SUCH SOILS ARE BASED ON HAND PENETROMETER READINGS

TERMS CHARACTERIZING SOIL STRUCTURE

Parting:	paper thin in size
Seam:	1/8"–3" thick
Layer:	greater than 3"
Fissured:	containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Sensitive:	pertaining to cohesive soils that are subject to appreciable loss of strength when remolded
Interbedded:	composed of alternate layers of different soil types
Laminated:	composed of thin layers of varying color and texture
Calcareous:	containing appreciable quanities of calcium carbonate
Well Graded:	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly Graded:	predominately of one grain size, or having a range of sizes with some intermediate size missing
Flocculated:	pertaining to cohesive soils that exhibit a loose knit or flakey structure
Slickensided:	having inclined planes of weakness that are slick and glossy in appearance

DEGREE OF SLICKENSIDED DEVELOPMENT

Slightly Slickensided:	slickensides present at intervals of 1'-2'; soil does not easily break along these planes
Moderately Slickensided:	slickensides spaced at intervals of 1'-2'; soil breaks easily along these planes
Extremely Slickensided:	continuous and interconnected slickensides spaced at intervals of 4"–12"; soil breaks along the slickensides into pieces 3"–6" in size
Intensely Slickensided:	slickensides spaced at intervals of less than 4", continuous in all directions; soil breaks down along planes into nodules 1/4"–2" in size

MONITOR WELL INSTALLATION

WELL NO.: OCD 4-1

ROJECT: Hazardous Waste Site

CASING SIZE & TYPE: 2" PVC

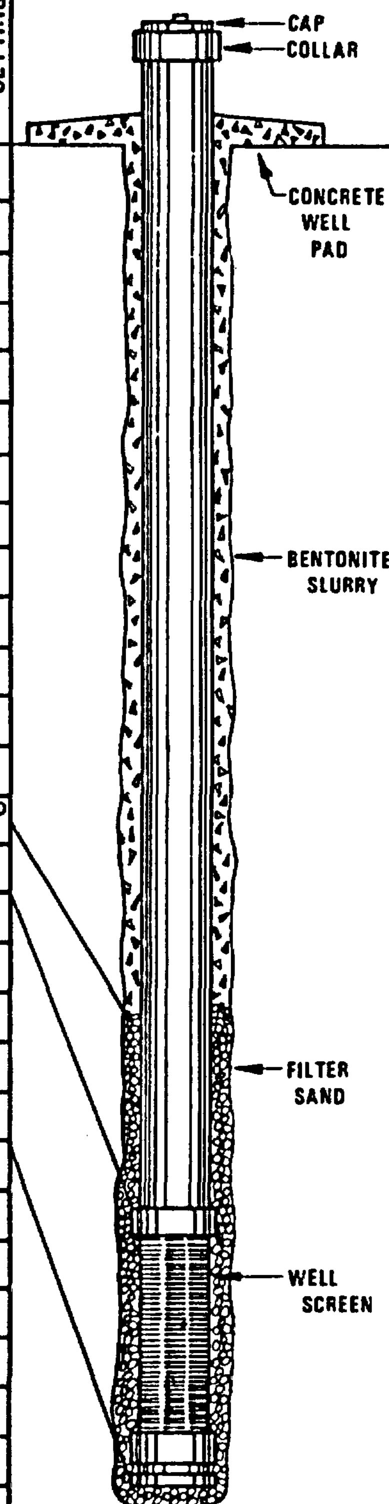
LIENT: Dow Chemical - Oyster Creek Division

SCREEN SIZE: 2" x 5' Rod base PVC

LEV.: SURFACE PAD 3.3 feet WELL HEAD 7.15

DATE DRILLED: 1-14-80

DEPTH	WATER LEVEL	SYMBOL	DESCRIPTION OF STRATUM	MATERIAL SETTING
	▽		Clay, highly plastic, soft, dark brown w/ roots to 1.5'	
			firm, reddish brown below 4'	
5				
			light gray and calcareous below 9'	
10				
				13.5
15				15
			Silty clay, slightly plastic, light gray	
			Sand uniform fine, light gray with calcareous nodules reddish brown @ 18.5'	
20				20
			TD @ 20'	



MONITOR WELL INSTALLATION

WELL NO.: OCD 4-2

PROJECT: Hazardous Waste Site

CASING SIZE & TYPE: 2" OD (PVC)

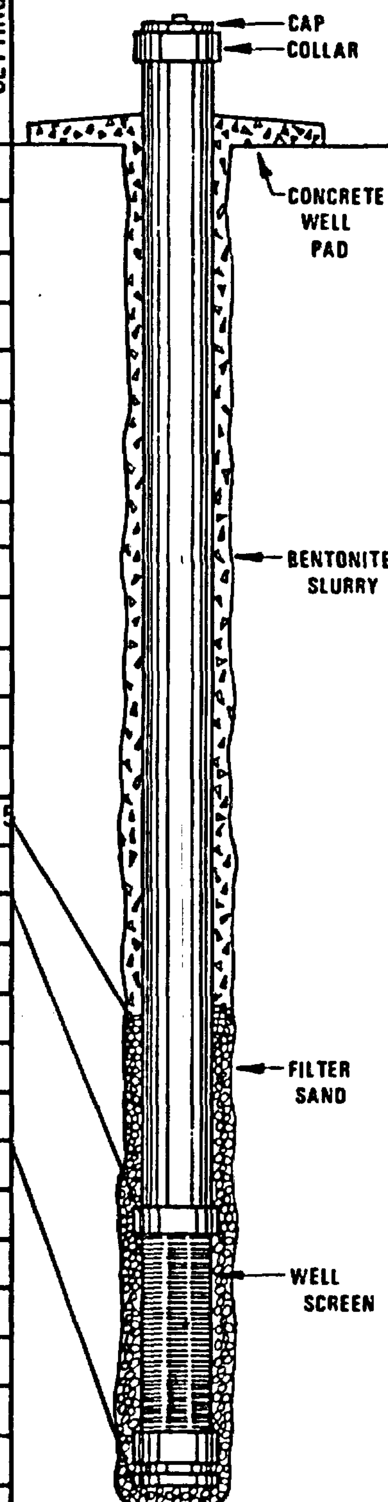
CLIENT: Dow Chemical - Oyster Creek Division

SCREEN SIZE: 2" x 5' rod base (PVC)

ELEV.: SURFACE PAD 3.18 WELL HEAD 6.85

DATE DRILLED: 1-15-80

DEPTH	WATER LEVEL	SYMBOL	DESCRIPTION OF STRATUM	MATERIAL SETTING
	▽		Clay, highly plastic, soft, dark brown, w/roots to 1.5'	
			firm, reddish brown and gray below 4'	
5				
10				
				13.5
15				15
			Sand, uniform fine, light gray with calcareous nodules	
20				20
			Clay, highly plastic, stiff reddish brown	
			TD @ 23'	



MONITOR WELL INSTALLATION

WELL NO.: OCD 4-3

JECT: Hazardous Waste Site

NT: Dow Chemical - Oyster Creek Division

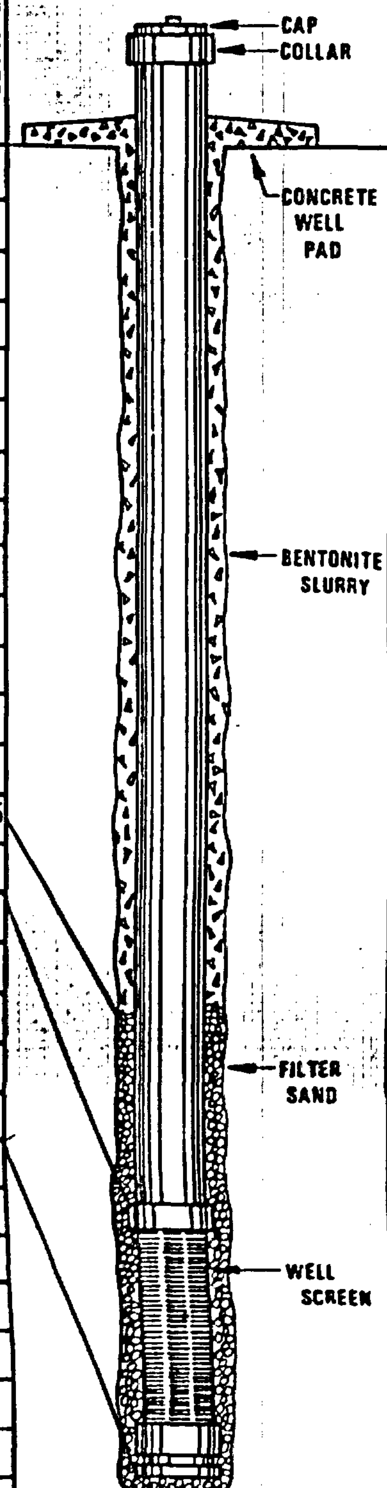
V.: SURFACE PAD 3.45 WELL HEAD 7.08

CASING SIZE & TYPE: 2" O.D. (PVC)

SCREEN SIZE: 2" x 5' rod base (PVC)

DATE DRILLED: 1-15-80

WATER LEVEL	SYMBOL	DESCRIPTION OF STRATUM	MATERIAL SETTING
▽		Clay, highly plastic, soft, dark brown w/roots to 1.5'	
		firm, reddish brown below 4'	
0		stiff, red and tan below 10.0'	
			13.5
5			15
0			20



MONITOR WELL INSTALLATION

WELL NO.: OCD 4-4

PROJECT: Hazardous Waste Site

CASING SIZE & TYPE: 2" O.D. (PVC)

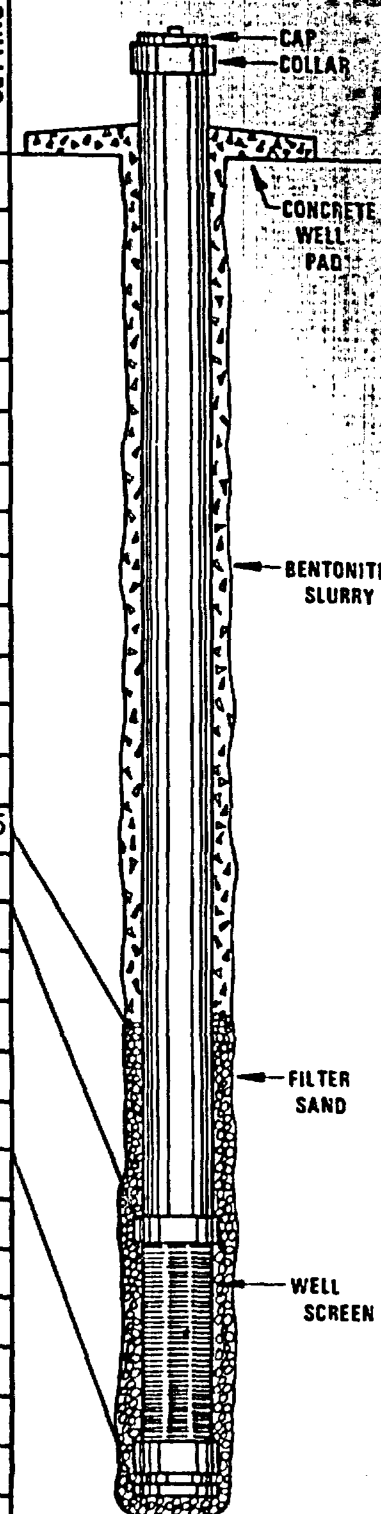
CLIENT: Dow Chemical - Oyster Creek Division

SCREEN SIZE: 2" x 5' rod base (PVC)

ELEV.: SURFACE PAD 3.5 **WELL HEAD** 7.29

DATE DRILLED: 1-15-80

DEPTH	WATER LEVEL	SYMBOL	DESCRIPTION OF STRATUM	MATERIAL SETTING
	▽		Clay, highly plastic, soft, dark brown w/roots to 1.5'	
			firm below 4.0'	
5				
			gray with reddish brown stains	
10				
				13.5
15			calcareous nodules and calichification to 20.0'	15
20			TD @ 20'	20



MONITOR WELL INSTALLATION

WELL NO.: OCD 4-5

PROJECT: Hazardous Waste Site

CASING SIZE & TYPE: 2" O.D. (PVC)

CLIENT: Dow Chemical - Oyster Creek Division

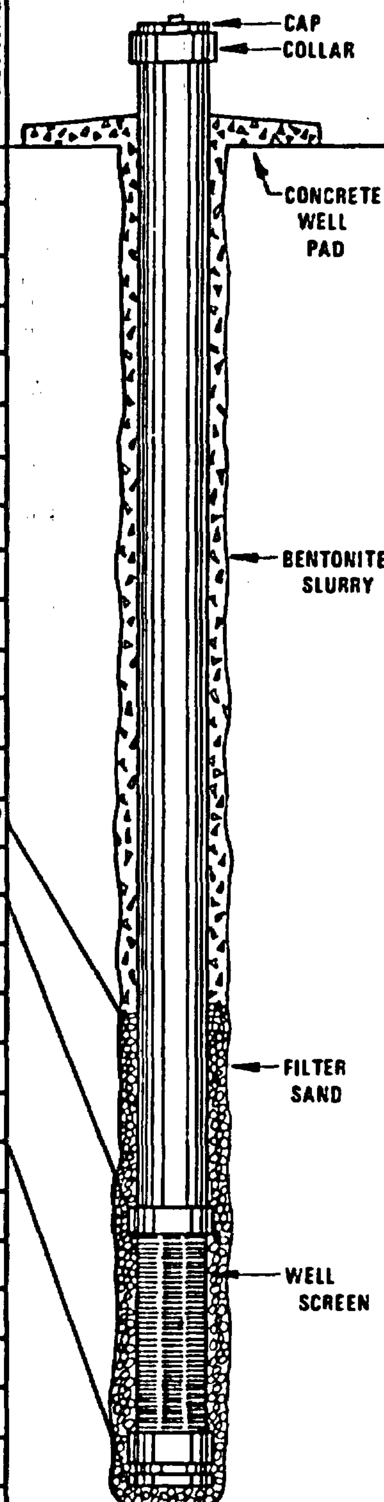
SCREEN SIZE: 2" x 5' rod base (PVC)

ELEV.: SURFACE PAD 2.48 WELL HEAD 5.81

DATE DRILLED: 1-9-80

DEPTH	WATER LEVEL	SYMBOL	DESCRIPTION OF STRATUM	MATERIAL SETTING
	▽		Clay, highly plastic, soft, dark reddish brown clay w/roots to 1.5'	
			firm below 4.0'	
5				
10			calcareous nodules @ 10.0'	
				13.5
15			Silty Clay, slighty plastic, reddish brown Sand, seam @ 14 ft.	15
			Clay, highly plastic, stiff, reddish brown	
20			TD @ 20' *	20

* Boring was drilled to 40' and back-filled to 20' prior to monitor well installation.



All Gas chromatograph tests contained in this report were performed by the Dow Chemical Company. The following data was supplied by the Laboratory.

Chlorinated Hydrocarbon Scans:

5700 FID Hewlett-Packard Gas Chromatograph

16% Polygrease on Chromosorb W - AWDMST 80 - 100 MESH

14 ft. SS 1/8" Thin Wall Isothermal @ 75°C

Carrier Gas - Nitrogen 30 cc/min,

Hydrogen 30 cc/min, Air 240 cc/min.

Detector Temp. 200°C

Injection Port 150°C

Sample: 25 mls sample extracted for 5 min. with N_2.

1 ml gaseous injection

Attenuation X16.

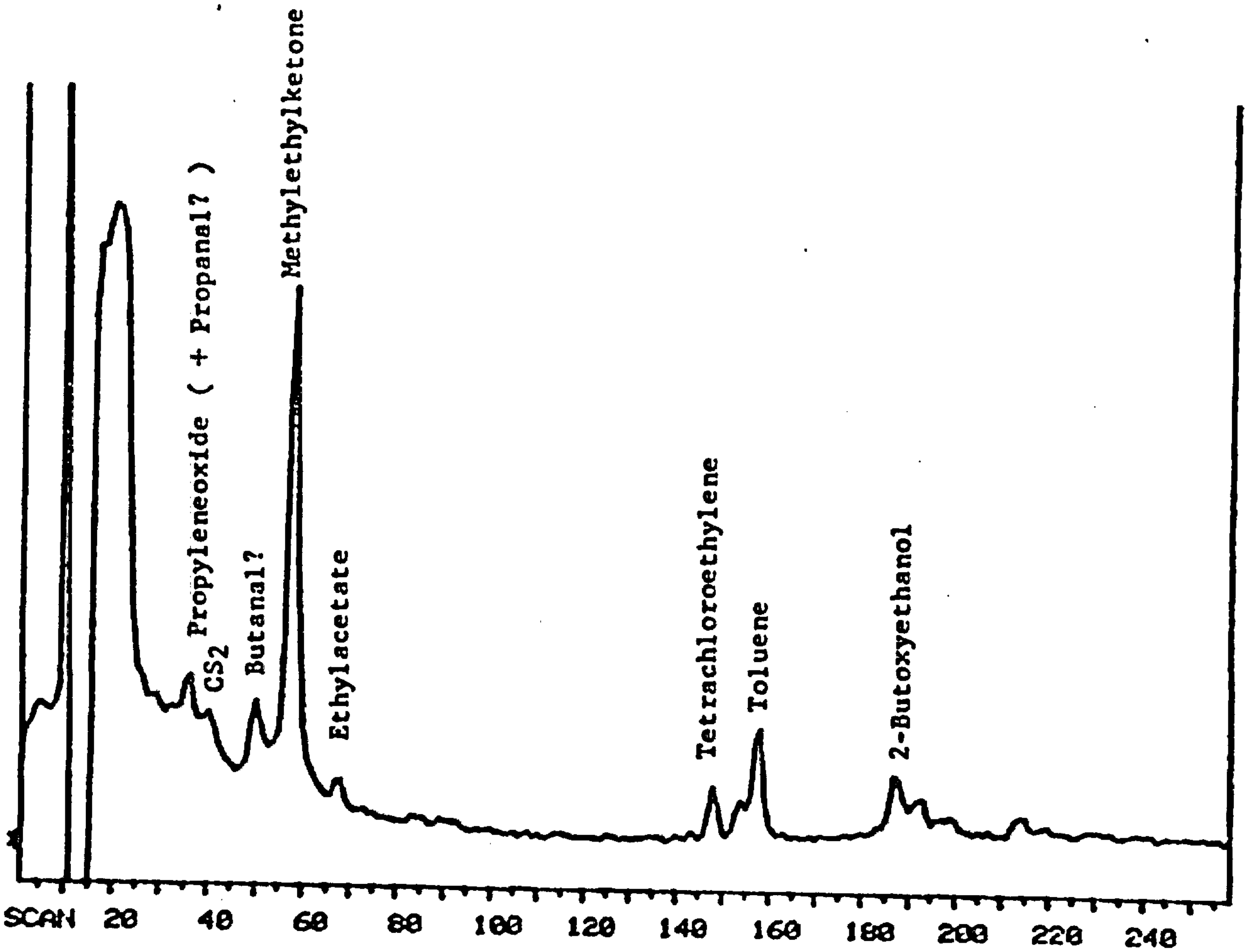
The Gas Chromotagraph scan on page F-3 was performed on a sample collected after monitor well OCD 4-1 was completed. This scan pattern corresponds with a scan of distilled water with PVC pipe and cement immersed (Page F-4). The three scans on page F-5 are of water samples in the borehole (through the auger) and are probably more representative of the native groundwater. The sharp peak at the bottom is present in all scans (even of a Nitrogen Blank, F-6). The other two peaks are unknown at this time. The scan on page F-7 is a typical chlorinated hydrocarbon scan, and F-8 is a scan of a composite liquid surface sample from solid waste site 75-2 and 75-3. These scans would be indicative of ground-water pollution.

Three samples were collected for GC-MS analysis: F-9, F-10 and F-11. The scan on Page F-9, identified as monitor well 3A, was performed on a sample of water collected before PVC casings and screen was installed. The scan on F-10 (identified as monitor well 3B) was performed on a sample collected after pipe and screen were installed. Currently, an explanation is not available for the peaks observed in scan 3A.

THE DOW CHEMICAL COMPANY

TEXAS DIVISION

CENTRAL LABORATORY FREEPORT



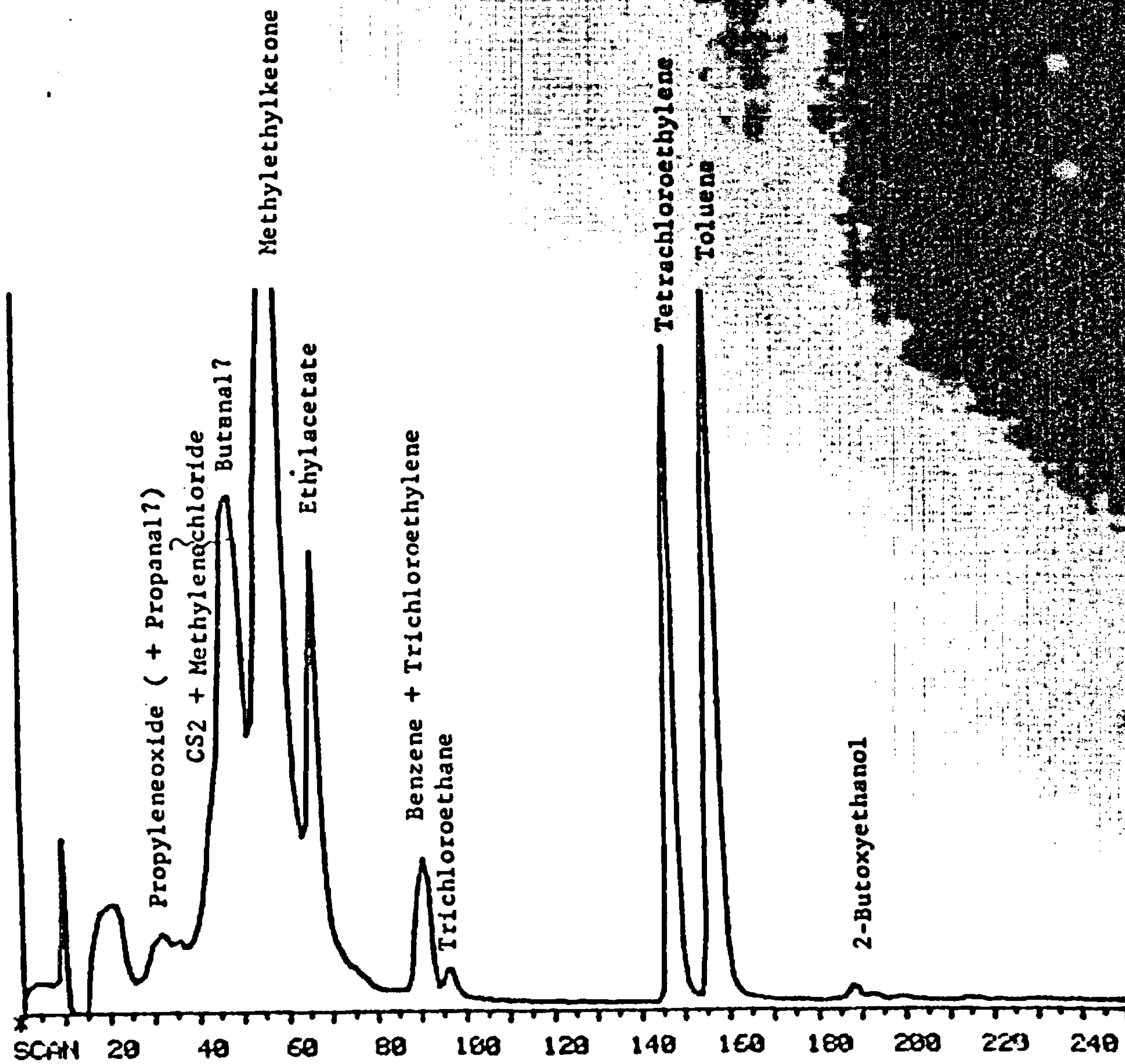
SAMPLE: Monitor Well Water (Tekmar) 3A
COLUMN: 0.2% Carbowax 1500 on 60/80 Carbopak C (#5)
TEMPERATURE: 60°C-170°C @ 12°C/min.
DATE: 1/25/80

BY: Lonnie Kay [signature]

LGH/CL6443-5 dc

SIGNED B. A. Allen Jr.

THE DOW CHEMICAL COMPANY
TEXAS DIVISION
CENTRAL LABORATORY FREEPORT



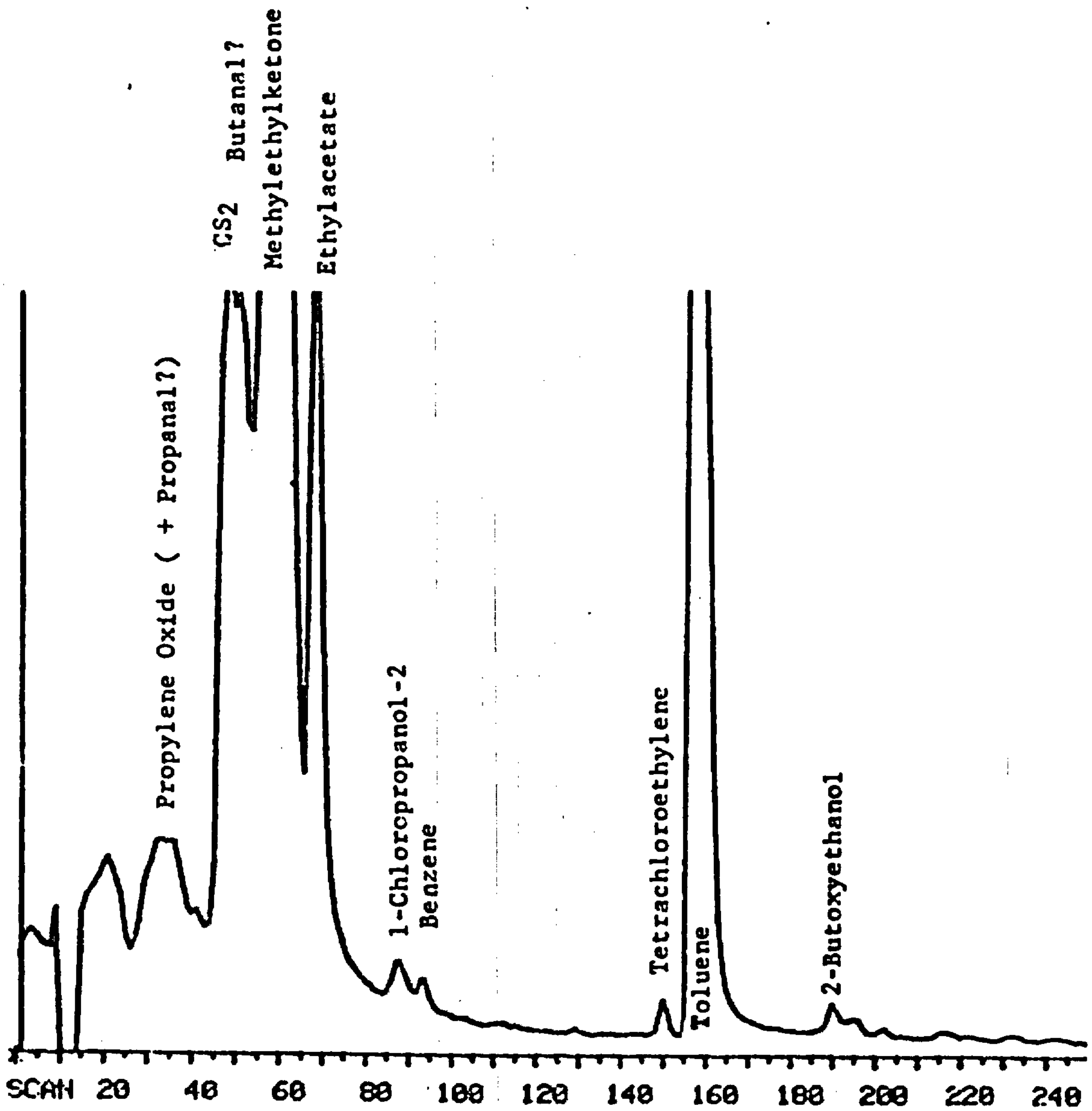
<u>SAMPLE</u>: Moniter Well Water (Tekmar) 3B
<u>COLUMN</u>: 0.2% Carbowax 1500 on 60/80 CarbopakC (#5)
<u>TEMPERATURE</u>: 60°C-170°C @ 12°C/min.
<u>DATE</u>: 1/25/80

BY: Lonnie Kapitil
LGH/CL6443-5 dc

SIGNED B. A. Allen Jr.

THE DOW CHEMICAL COMPANY
TEXAS DIVISION

CENTRAL LABORATORY FREEPORT

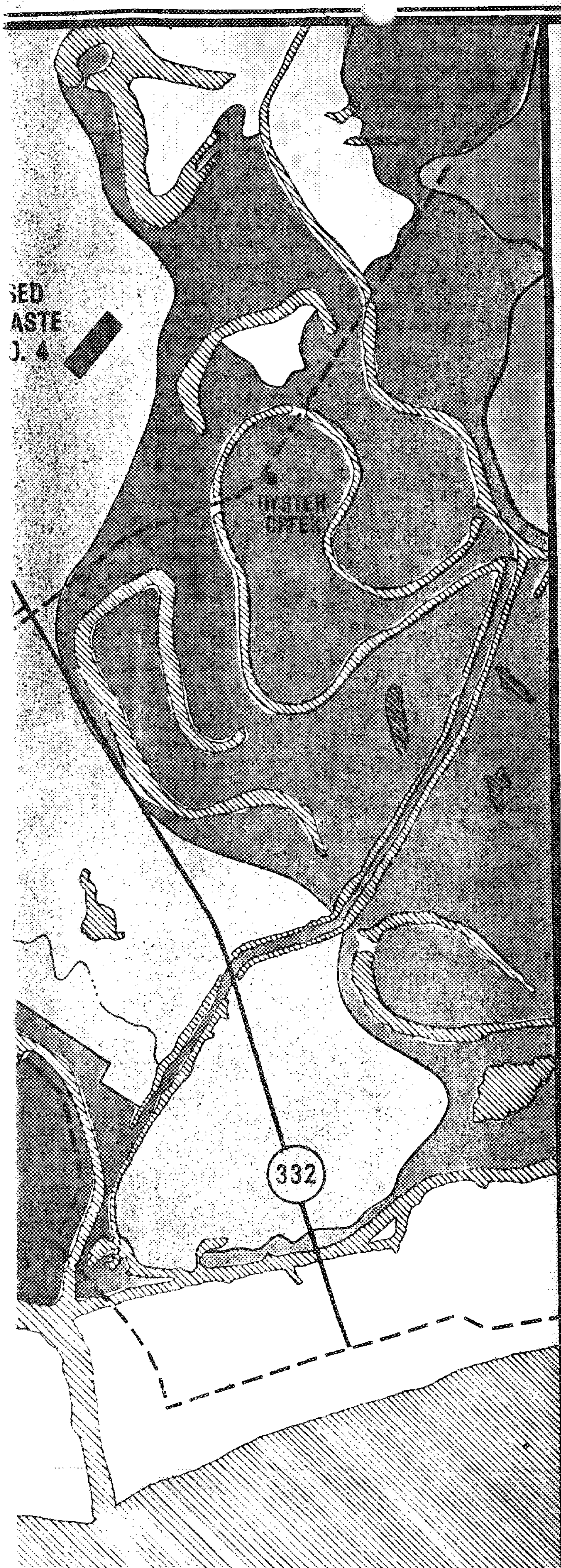


SAMPLE: Monitor Well Water (Tekmar) 2B
COLUMN: 0.2% Carbowax 1500 on 60/80 Carbopak C (#5)
TEMPERATURE: 60°C-170°C @ 12°C/min.
DATE: 1/25/80

BY: Lonnie Kay Litt

LGH/CL6443-5 dc

SIGNED B. A. Allen Jr.



DOW CHEMICAL U.S.A.

Oyster Creek Division

FREEPORT, BRAZORIA COUNTY, TEXAS

PLATE 4

GENERALIZED ENVIRONMENTAL GEOLOGIC MAP

PREPARED BY
UNDERGROUND RESOURCE MANAGEMENT

EXPLANATION

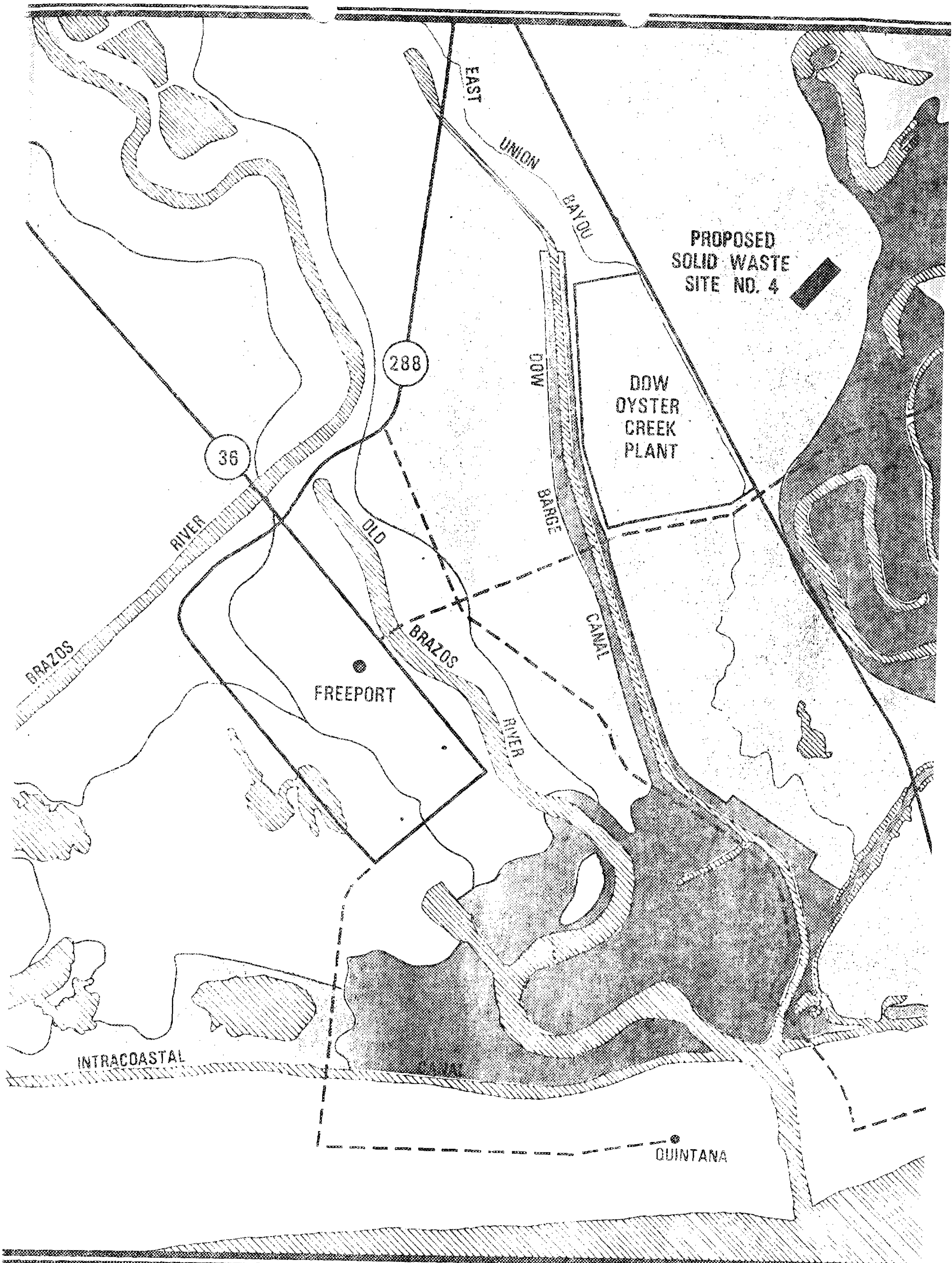
- MAN MADE LAND
- PRO DELTA MUDS, NATURAL LEVEE AND CREVASSE SPLAY DEPOSITS
- MARSH, FRESH TO BRACKISH WATER LOCALLY SAND SUBSTRATE
- FLUVIAL SAND AND FLOOD BASIN MUD, INACTIVE, NONENTRENCHED STREAM
- INTERDISTRIBUTARY MUD, BAY AND FLOOD BASIN DEPOSITS
- MEANDER BELT SANDS, LEEVEE AND CREVASSE SPLAY DEPOSITS

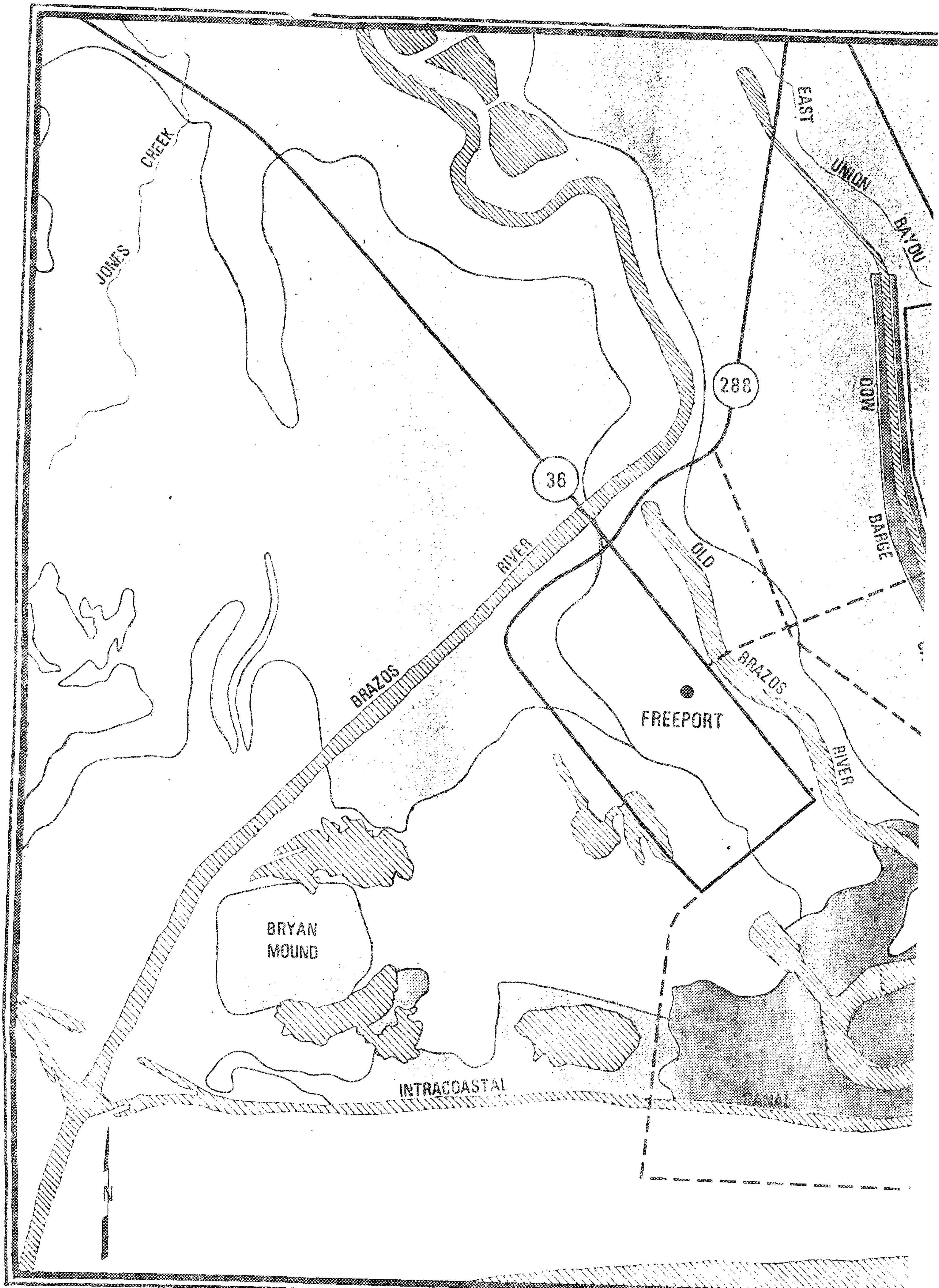
SCALE

0 1/2 1

MILE

ADAPTED FROM: BUREAU OF ECONOMIC GEOLOGY, (1975)


EAST
UNION
BAYOU
PROPOSED
SOLID WASTE
SITE NO. 4
288
DOW
BARGE
CANAL
DOW
OYSTER
CREEK
PLANT
36
RIVER
OLD
BRAZOS
RIVER
BRAZOS
FREEPORT
INTRACOASTAL
CANAL
QUINTANA



JONES
CREEK
EAST
UNION
BAYOU
DOW
BARGE
288
36
RIVER
BRAZOS
OLD
BRAZOS
RIVER
FREEPORT
BRYAN
MOUND
INTRACOASTAL
CANAL
N